

# Managing deployment of ERP systems in SMEs using multi-agents

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Received 25 June 2002; received in revised form 10 September 2002; accepted 16 December 2003

## Abstract

Despite the many advantages of Enterprise Resources Planning (ERP) systems, they do not as yet represent a clear and successful management tool to small and medium sized enterprises (SMEs), or at least it is not as easily implementable by SMEs. This paper shares some insight into a research aimed at identifying the strategic and operational requirements of SMEs in the South East Asia (SEA) region. It highlights a set of organizational, operational and supply chain related interdependencies in SMEs which in many aspects influence project management success and methodologies deployed in ERP systems in SMEs. An agent-based model for coordinating the management of enterprise resource in SMEs is also introduced. This model expounds on how the various enterprise resources in an SME can be organized, interfaced and managed. By drawing upon this model, we can relate to how SMEs can better project managed ERP systems in their usually informal systems.

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*Keywords:* Project management; Enterprise Resources Planning; Supply chain management

## 1. Introduction

Enterprise Resources Planning (ERP) system offers a viable management tool to helping companies in particular manufacturing enterprises manage their resources. The exponential growth in technologies and innovation in manufacturing and information processing is pushing companies into a new paradigm shift. Numerous companies who have successfully implemented ERP systems testified to its 'life-saving' importance. However, SMEs must not blindly embrace ERP projects. The improper project planning and poor adoption of ERP may mean realigning the company's comparative advantage position which SMEs can dearly afford.

Thus far, ERP projects adoption has been the domain of the larger organizations. Features and business process flow have been designed based on practices in the large organizations. Consulting and project management methodologies are normally specified based on such experiences. The needs, operating requirements,

logistics fulfillment and financial capabilities of the SME manufacturers are vastly different from that of the large and medium sized manufacturers. Adoption of information technology by SMEs in managing their ERP projects is also limited. While ERP is sufficiently flexible to cope with the general manufacturing enterprises, we need to take a closer look at the strategic and operational needs of SMEs before we can properly develop a project management strategy for them.

## 2. Strategic and operational requirements of SMEs

A huge pool of SMEs exist to service the 1st and 2nd tier corporations (huge and fairly large enterprises, respectively) or to provide specialty or outsourcing services to these corporations. Manufacturing has been identified as a key pillar of growth in most economies in SEA. Manufacturing contributes 25% and 35% of Singapore's and Malaysia's GDP [3], respectively. There are more than 100,000 SMEs in Singapore and 500,000 SMEs in Malaysia. In terms of numbers, SMEs form 80% of the companies' entities in the economy and contribute 29% of the Singapore GDP in 2000 [3]. However, ERP projects implementation in SMEs in

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SEA is still fairly low with less than 50% acceptance [5]. This could largely be attributed to the inadequate project management methodologies and systems designed for the SMEs in this newly industrialized region.

SMEs do not function as a collection of formal structured departments. Project implementation of ERP systems in SMEs is simpler in some aspects and more complicated at times. There is a marked lack of research on interdependencies of the various enterprise resources in SMEs especially for the SEA region which is one of the world's major manufacturing hub. A study was conducted [6] to examine the dynamics of enterprise resources planning in SMEs in the SEA and how these are impacted due to internal and external effects on the SMEs. The objective was to establish the strategic and operational requirements (SOR) of SMEs and examine its possible impact on ERP systems project management and deployment. The guidelines of the Infocomm Development Authority of Singapore are used in defining SMEs as entities with: Fixed assets less than S\$15million; and, Number of full-time employees less than 200. Companies, which are "very small" and for which implementation of an ERP system may not be that advantageous, are omitted. These are SMEs which are on the lower spectrum of the above criteria. These constitute a very big number of SMEs.

The first part of this paper presents the dynamics of enterprise resources in the 30 SMEs case study conducted through 95 surveys and interviews with the aid of a prepared questionnaire. The targeted M-SMEs, from the electronics and related precision engineering industry, are selected from a list of 958 representative M-SMEs that have reached a certain critical size making ERP a logical management tool. The understanding of these factors is paramount to any development of methodologies in project management for ERP in SMEs.

### 2.1. *Low levels of organizational hierarchy*

The average number of structural hierarchies found in SMEs is 3.133. The chief executive officer (CEO) is involved in most strategic decisions and major operational decision-making in the SME. He is usually one of the key founders and has been closely involved in the establishment of the SME. Of the 15 local SMEs, 13 CEOs are major shareholders, founders or closed relatives of the principals. Two are minor shareholders tasked with managing the company. Of the 15 foreign SMEs, 12 CEOs are directly responsible for some key aspects of operations, e.g. major account management and regional sales management.

At the middle level are two distinct groups of direct operational managers: the professionals and 'upgraders'. The former have graduate or professional education and previous rich experience. Majority of the latter group

managers have years of related work experience and intimate knowledge of the operational tasks, sometimes across different departments in the SME. This knowledge is very useful to the SMEs as it allows cross-checking and network decision-making. At the execution level are the professionals (e.g. the planners, buyers, production supervisors, etc). With globalization and competition, more professionals and graduates are hired into these line execution jobs. This group is usually I.T. literate and spearheads the ERP project adoption.

### 2.2. *CEO involvement in operational decisions*

The CEOs in SMEs are involved in strategic charting of their enterprises and are also high-level line managers. In spite of having designated line managers, in all 30 case studies, the CEOs directly drive some line functions. In 26 of the 30 companies, the CEO is involved in purchasing operations; in 22 of the 30, the CEO is involved in high-end purchase functions; and in 26 of the 30, the CEOs are involved in sales account management functions. This is common across both local and foreign SMEs. This unique characteristic implies that the CEO may be conductor of the orchestra and at the same time may be a project team member in any ERP implementation, thus impacting how ERP can be project managed at SMEs.

### 2.3. *"Blurred" departmental walls*

This refers to inter-departmental boundaries with no clear line of portfolio responsibility. In 17 of the 30 SMEs, a manager designated as the manager-in-charge of a department is also directly responsible for another department. E.g. in 6 SMEs, a sales manager is also in-charge of the purchasing department; in 6 SMEs, the production planning manager is also overseeing the production department; in 5 companies, the accountant is also directly responsible for the purchasing department, etc. In these 17 SMEs, the middle level managers are assigned to manage more than one department at the same time. This makes departmental walls "blurred" and may result in conflict of interests. 20 of the 30 companies also reported that some key managers have significant influence over the operations and decision-making in another department which is not under their direct charge. This overlap of departmental boundaries can result in some benefits for the SMEs but issues on such "blurred" departmental walls need to be well contained when project managing a more formal and structured system such as ERP.

### 2.4. *Production modes in SMEs*

SMEs are usually supporting manufacturers of 1st and 2nd tier corporations with 20 of the 30 companies

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